silicon or glass. In step 4 (wafer process) called a preprocess, an actual circuit is formed on the wafer by lithography using the prepared mask and wafer. In step 5 (assembly) called a post-process, a semiconductor chip is formed from the wafer prepared in step 4. This step includes processes such as assembly (dicing and bonding) and packaging (chip encapsulation). In step 6 (inspection), inspections including an operation check test and a durability test of the semiconductor device manufactured in step 5 are performed. A semiconductor device is completed with these processes and delivered (step 7). --

REMARKS

Applicants request favorable consideration and allowance of the subject application in view of the preceding amendments and the following remarks.

Claims 1-36 are presented for consideration. Claims 1, 10, 23, and 32-36 are independent.

Applicants submit that the instant application is in condition for allowance. Favorable consideration and an early Notice of Allowance are requested.

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Applicants' undersigned attorney may be reached in our Washington, D.C. office by telephone at (202) 530-1010. All correspondence should be directed to our address listed below.

Respectfully submitted,

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<u>APPENDIX A</u>

<u>IN THE SPECIFICATION</u>

On page 1, please insert before the first line the following paragraph:

-- <u>This application is a continuation of copending application no. 09/388,372, filed September 1, 1999, and allowed on October 23, 2001.</u> --

Please substitute the paragraph beginning at page 1, line 13 with the following.

-- The position detection apparatus of the present [nvention] <u>invention</u> can be applied to, e.g., a surface position measuring apparatus for measuring a small distance by an electrostatic scheme. The exposure apparatus of the present invention can be applied to, e.g., a slit-scan exposure apparatus. --

Please substitute the paragraph beginning at page 4, line 1 with the following.

-- This problem can be solved by using an electrostatic sensor as a focus detection sensor. An electrostatic sensor is more advantageous as a focus detection sensor of a slit-scan exposure apparatus than an optical sensor because it can almost uniformly average within the detection area, does not generate any focus detection error at an edge portion, and has <u>a</u> high response speed. --

Please substitute the paragraph beginning at page 5, line 4 with the following.

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-- In addition, when the shape of the wafer surface changes to a shape incompatible with [to] the apparatus because of the repeated lithography process, the above-described surface position detection apparatus cannot accurately detect the surface position of the substrate. --

Please substitute the paragraph beginning at page 6, line 23, and ending on page 7, line 1, with the following.

-- In the position detection apparatus according to the first aspect, for example, the selection section [preferably selects at least one detection section such that] determines the number of detection sections to be [selected changes] used for measurement. --

Please substitute the paragraph beginning at page 7, line 6 with the following.

-- In the position detection apparatus according to the first aspect, for example, preferably, the apparatus comprises at least two sets of the at least two detection sections, the selection sections, and the measurement devices, and further comprises an arithmetic section for calculating a tilt of the object surface on the basis of a measurement result by the at least two measurement device. --

Please delete the paragraph beginning at page 8, line 21and ending on line 24.

[In the exposure apparatus according to the second aspect, for example, the selection section preferably alternatively selects one detection section from the at least two detection sections.]

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Please substitute the paragraph beginning at page 8, line 25, and ending on page 9, line 2, with the following.

-- In the exposure apparatus according to the second aspect, for example, the selection section preferably [selects at least one detection section such that] determines the number of detection sections to be [selected changes] used for measurement. --

Please substitute the paragraph beginning at page 9, line 11 with the following.

-- In the exposure apparatus according to the second aspect, for example, the selection section preferably selects the detection section to be used for measurement [not] to measure the position of the substrate in a direction other than in a [the] direction normal thereto on a scribing line of the substrate. --

Please substitute the paragraph beginning at page 9, line 22, and ending on page 10, line 1, with the following.

-- In the exposure apparatus according to the second aspect, for example, the selection section preferably determined detection sections to be used for measurement [to reflect, on the measurement result,] in accordance with a position of an exposure area on the substrate [in the direction normal thereto where high resolving performance is required]. --

Please substitute the paragraph beginning at page 15, line 26, and ending on page 16, line 6, with the following.

-- According to the [10th] tenth aspect of the present invention, there is provided an exposure apparatus comprising the surface position detection apparatus for detecting a position

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of a surface to be exposed, and means for controlling the selection means in correspondence with a state of the surface to be exposed, whose surface position is to be detected. --

Please substitute the paragraph beginning at page 16, line 7 with the following.

-- According to the [11th] eleventh aspect of the present invention, there is provided a device manufacturing method using the exposure apparatus, comprising the steps of detecting a surface position of a substrate to be exposed while appropriately selecting an electrode to be used in each electrostatic sensor by the surface position detection apparatus of the exposure apparatus, and exposing the substrate while controlling the position of the substrate to be exposed on the basis of a detection result. --

Please substitute the paragraph beginning at page 16, line 17, and ending on page 17, line 4, with the following.

-- According to this arrangement, even when the chip layout of a print pattern of a wafer, i.e., the surface to be detected changes, an electrode to be used in each electrostatic sensor is selected in correspondence with the change. Distance measurement for surface position detection is performed by making the electrode oppose a preferable measurement position or measurement area. Since the electrode is simply selected by the selection means, the high-frequency voltage to be applied is common to the electrodes appropriately selected in each electrostatic sensor and, therefore, is constant for the electrodes. Hence, accurate surface position detection is performed in correspondence with a change in the surface to be detected. --

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Please substitute the paragraph beginning at page 18, line 5 with the following.

-- The slit-scan exposure apparatus may comprise a surface position detection apparatus having the variable distance measurement position electrostatic sensor to detect the position in the direction of the exposure optical axis for pre-measurement for focus position control of the surface to be exposed. In this case, the exposure apparatus comprises means for controlling the switching means such that a large part of an exposure surface position where high resolving performance is required is included in the measurement area. --

Please substitute the paragraph beginning at page 18, line 15, and ending on page 19, line 2, with the following.

-- The means for controlling the switching means can perform control on the basis of the exposure layout. Under the control, even when the exposure width becomes small, electrodes are selected such that the electrodes for calculating the tilt angle of the surface to be exposed are located within the width, thereby performing accurate focus position control. In addition, if a scribing line is located within the exposure slip, the electrode can be switched to cope with a plurality of chip patterns. In the surface position detection apparatus having the variable distance measurement position electrostatic sensor, the detection area to be averaged can be changed by switching the electrode to cope with a plurality of different chip layouts. --

Please substitute the paragraph beginning at page 23, line 8 with the following.

-- Fig. 12 is a view showing a conventional layout of electrostatic sensors when viewed from one direction of the optical axis. Reference numeral 25 denotes an exposure slit; and 27, a scanning direction. In this example, three sensors 201 to 203 are used as an electrostatic

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sensor (corresponding to the electrostatic sensor 20) to detect the height and tilt of a wafer. Since the electrostatic sensors cannot directly measure the surface position at the exposure position, pre-measurement is performed by the sensors 201 to 203 mounted at positions separated from the exposure slit 25 by a predetermined distance in the scanning direction. Actually, since scanning is performed in the negative direction of the X axis, similar sensors must be mounted as an electrostatic sensor (corresponding to the electrostatic sensor 20′) in the negative direction, as described above with reference to Fig. 11, though they are not illustrated for [the] descriptive convenience. --

Please substitute the paragraph beginning at page 18, line 26, and ending on page 24, line 14, with the following.

-- Fig. 13 is a view showing the arrangement in Fig. 12 when viewed from one scanning direction (positive side of the Y axis). Reference numeral 26 denotes a surface (conductor) of an object (wafer) to be measured. The same reference numerals as in Figs. 11 and 12 denote the same parts in Fig. 13. Referring to Fig. 13, the sensor 202 is used to detect the height of the wafer, and the sensors 201 and 203 are used to detect its tilt. Let S1, S2, and S3 be the outputs from the sensors 201 to 203, respectively. Then, the height Z [μm] and tilt ωx [rad.] are given by

$$Z = S2 \ [\mu m]$$

$$\omega x = (S1 - S3)/L \ [rad.]$$

(where L is the distance between the sensors 201 and 203). --

Please substitute the paragraph beginning at page 28, line 13 with the following.

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-- Fig. 19 is an explanatory view of a sensor electrode selection method. The variable distance measurement position electrostatic sensors 401 and 402 are used to calculate the tilt angle of a wafer. The sensor electrode 301 constructs the variable distance measurement position electrostatic sensor 401, and the sensor electrodes 305 and 307 construct the variable distance measurement position electrostatic sensor 402. Reference numeral 26 denotes the surface of a wafer (object to be measured). For [the] illustrative convenience, the sensor for detecting the height and the remaining sensor electrodes are omitted. The same reference numerals as in Fig. 3 and the like denote the same parts in Fig. 19. --

Please substitute the paragraph beginning at page 29, line 17, and ending on page 30, line 4, with the following.

-- In the example shown in Fig. 3, from the electrodes 303 to 306 positioned within the exposure width 28, not the electrodes 304 and 305 but the electrodes 303 and 306 that maximize the distance L′ between the sensor electrodes are selected. As a consequence, yawing of the object to be measured can be accurately measured, and accurate focus control can be performed. Selection of sensor electrodes and actual processing of selecting the sensor electrodes by using the switch are automatically done according to a program stored in the surface position detection apparatus. Since the user need not be aware of the algorithm or perform <u>any</u> operation, <u>a</u> cumbersome operation is unnecessary, and no errors occur. --

Please substitute the paragraph beginning at page 30, line 5 with the following.

-- Fig. 14 is a view for explaining a problem posed when not the application example described with reference to Fig. 3 but the conventional electrostatic sensor shown in Fig. 10

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is used for the surface position detection apparatus. The same reference numerals as in Figs. 3 and 12 denote the same parts in Fig. 14. Referring to Fig. 14, the sensors 201 and 203 for detecting the tilt angle are positioned outside the exposure area. A wafer having a step difference on its surface because of the repeated process of forming layers has a large step difference between the interior and exterior of the exposure area. For this reason, yawing of the wafer calculated on the basis of the distance between the sensor electrode and the wafer surface, which is detected outside the exposure area, and yawing of the surface within the exposure area, which [need] needs to be actually measured, do not match. Accordingly, accurate focus control cannot be performed. However, as described with reference to Fig. 3, when the electrostatic sensor according to the present invention is used as a tilt angle detection sensor, the problem described with reference to Fig. 14 can be solved. --

Please substitute the paragraph beginning at page 33, line 16, and ending on page 34, line 8, with the following.

-- A method of selecting a sensor electrode to be used, i.e., determining the distance measurement position when the variable distance measurement position electrostatic sensor is applied as a sensor for calculating the tilt angle will be described next. As described with reference to Fig. 5, in the exposure process, the sensor electrode to be selected may change depending on the position of the exposure slit 25. When the exposure slit 25 is positioned near the outer peripheral portion of the wafer 5, a sensor electrode within the area of the wafer must be selected. On the other hand, when the exposure slit 25 is not near the outer peripheral portion, an electrode position determined in advance on the basis of the exposure width calculated immediately after chip layout data is input before the start of an exposure process

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is selected. That is, a sensor electrode that falls within the exposure width 28 and is located on the outermost side of the area of the wafer is selected. --

Please substitute the paragraph beginning at page 35, line 14, and ending on page 36, line 2, with the following.

-- Selection of the sensor electrode and actual processing of selecting the sensor electrode by using the switch are automatically done according to a program stored in the surface position detection apparatus. Since the user need not be aware of the algorithm or perform <u>any</u> operation, <u>a</u> cumbersome operation is unnecessary, and no errors occur. Switching is performed on the basis of the chip layout data before the start of <u>an</u> exposure process. The reason for this is as follows. Since the chip layout (pattern) is common to one wafer and does not change during exposure of the wafer, the sensor electrode used to detect the height does not change during the exposure process. The sensor electrode to be used to detect the height is determined on the basis of the exposure width determined from the data. --

Please substitute the paragraph beginning at page 40, line 15, and ending on page 41, line 9, with the following.

-- [Am] <u>An</u> embodiment of a device manufacturing method using the above-described exposure apparatus will be described next. Fig. 21 shows the flow of manufacturing a microdevice (e.g., a semiconductor chip such as an IC or an LSI, a liquid crystal panel, a CCD, a thin-film magnetic head, or a micromachine). In step 1 (circuit design), the pattern of a device is designed. In step 2 (mask preparation), a mask having the designed pattern is

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prepared. In step 3 (wafer manufacture), a wafer is manufactured using a material such as silicon or glass. In step 4 (wafer process) called a preprocess, an actual circuit is formed on the wafer by lithography using the prepared mask and wafer. In step 5 (assembly) called a post-process, a semiconductor chip is formed from the wafer prepared in step 4. This step includes processes such as assembly (dicing and bonding) and packaging (chip encapsulation). In step 6 (inspection), inspections including an operation check test and a durability test of the semiconductor device manufactured in step 5 are performed. A semiconductor device is completed with these processes and delivered (step 7). --

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